GB0410407 2

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed Stephen Hordley

Dated 30 September 2004

Patents Form 1/77

Patents Act 1977
(Rule 16)

The Patent Office

THE PATENT OFFICE
JL
26 SEP 2003
RECEIVED BY FAX

26SEP03 E840309-1 D02973
P01/7700 0.00-0322591.9

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP9 1RH

1. Your reference

P102599GB

2. Patent application number
(The Patent Office will fill in this part)

26 SEP 2003 0322591.9

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Hawke Cable Glands Limited
Oxford Street West
Ashton-Under-Lyne
Lancashire
OL7 0NA

00491712001

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention

An electronic circuit

5. Name of your agent *(if you have one)*

Harrison Goddard Foote

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Orlando House,
11c Compstall Road
Marple Bridge
Stockport
SK6 5HH

Patents ADP number *(if you know it)*

00014571002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	-
Description	8 ✓
Claim(s)	3 ✓
Abstract	1 ✓
Drawing(s)	1 only one

10. If you are also filing any of the following, state how many against each item.

Priority documents	-
Translations of priority documents	-
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	1 ✓
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	Letter ✓

11. I/We request the grant of a patent on the basis of this application.

Signature Harrison Goddard Foote Date

HARRISON GODDARD FOOTE 26/09/03

12. Name and daytime telephone number of person to contact in the United Kingdom Sean Thomas, 0161 427 7006

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

f) *For details of the fee and ways to pay please contact the Patent Office.*

An electronic circuit

The present invention relates to electronic circuits and particularly electronic circuits suitable for terminating a transmission path or channel, such as a communication network, for example, a transmission bus network or daisy chain system.

For the benefit of clarity the present invention will be described in relation to bus networks. However, the reader will appreciate that the present invention is equally applicable to other network systems such as, for example, daisy chain systems.

A bus network is a plurality of conductors, which serve as a common connection for a group of devices. Although transmission bus networks may comprise any number of conductors, for simplicity the present invention will be described in relation to a two-conductor bus network. However, the reader will appreciate that the invention is equally applicable to networks having more than two conductors.

In order to substantially mitigate, or limit, errors in signals being transmitted, maintenance of the integrity of the transmitted signal and minimising propagation delays and power consumption are important considerations in the engineering of transmission bus networks.

These considerations are substantially addressed by terminating the network with a terminating circuit having appropriate matching impedance. It is normal practice to terminate the network at both ends, that is, at the host and at the end node of the active network. This is generally carried out by manual selection and installation of the termination circuit, which typically comprises a terminating resistor in series with a terminating capacitor. A typical network will have multi-drop connections at nodes, which are interfaced to local devices.

A disadvantage of known networks of this type is that, upon occurrence of a fault in the network system such as, for example, an open circuit, the signal integrity is lost. Furthermore, such faults are usually difficult to locate within a network and, in such a state, the network is difficult to maintain in a stable condition. This results in considerable amounts of time being spent locating and fixing the fault and maintaining communication between the host and the nodes in the network until the fault is fixed, which is undesirable.

Also, the signal integrity is dependent on the engineer ensuring terminating circuits are specified and fitted correctly and that none of the nodes upstream of the end node are fitted with terminating circuits. Furthermore, if a change or modification is carried out to the network it is necessary for the engineer to check the impedance characteristics of the whole network system. Again, this is undesirably time consuming and expensive.

An object of the present invention is to provide an electronic circuit capable of maintaining the integrity of transmitted signals by terminating the network at a node thereof.

A further object of the present invention is to provide a node comprising such an electronic circuit.

A further object of the present invention is to provide a network comprising a plurality of such circuits.

The present invention provides an electronic circuit, capable of terminating a plurality of conductors at, or near, a node on a network, comprising detecting means, operable to detect current in at least one of the plurality of conductors, and switching means operable to switch the circuit between being a continuing circuit, upon the detecting means detecting a current greater than a first predetermined threshold, and being a terminating circuit, upon the detecting means detecting current at, or less than, a second predetermined threshold.

The terminating circuit advantageously comprises impedance matching means. The impedance matching means may comprise a terminating resistor connected in series with a terminating capacitor.

The terminating circuit is preferably connected between the at least one of the plurality of conductors and the, or each, of the other conductors.

The network may be an active network and the node may be the end node of that active network.

The first threshold may be greater than the second threshold.

The detecting means preferably comprises a sensing resistor, connected in series with the at least one of the plurality of conductors, and means for detecting voltage across the sensing resistor. The means for detecting voltage is preferably a differential amplifier.

The switching means preferably comprises a transistor wherein the base terminal thereof is connected to an output of the detecting means. The collector terminal of the transistor is preferably connected to the impedance matching means and the emitter terminal is preferably connected to the, or each, of the other conductors.

The present invention also provides for a network node comprising an electronic circuit as herein defined in the preceding six paragraphs.

The present invention also provides a network comprising at least one electronic circuit as herein defined in the preceding six paragraphs.

The present invention will now be described by way of example, with reference to the following drawings, in which:

Figure 1 is a schematic diagram of an electronic circuit according to the present invention; and,

Figure 2 is schematic drawing of a network comprising the electronic circuit of Figure 1

Referring to Figures 1 and 2, an electronic circuit 10, suitable for terminating a two-conductor 12a and b network system 14 at, or near, a node 16 disposed thereon, comprises detecting means 18, switching means 20 and a terminating circuit 21. The two-conductor network system may be, for example, a two-wire transmission bus system.

The detecting means comprises a sensing resistor 22, connected in series with the first conductor 12a, and means to detect voltage across the sensing resistor 22 in the form of a differential amplifier 24. The differential amplifier 24 has first and second inputs, 26 and 28, and an output 30. The first and second inputs, 26 and 28, are connected to the first conductor 12a, across the sensing resistor 22.

The switching means 20 comprises a transistor 32 having a base terminal 34, collector terminal 36 and emitter terminal 38. Figure 1 shows a NPN bipolar resistor. However, it will be appreciated that other types of bipolar transistor, such as PNP, or field effect

transistor, such as a MOSFET, are equally applicable to working the invention. The switching means further comprises a limiting resistor 40.

The terminating circuit 21 comprises a terminating capacitor 42 connected in series with a terminating resistor 44, one end of the terminating circuit being connected to the first conductor 12a and the other end being connected to the second conductor 12b by way of the switching means 20.

The first and second inputs, 26 and 28, of the differential amplifier 24 are connected to the sensing resistor 22, such that the first input is connected upstream and the second input downstream of the sensing resistor. The direction of flow of current in the first conductor is from left to right in the drawings.

The limiting resistor 40 of the switching means 20 is connected, in series, intermediate the output 30 of the differential amplifier 24 and the base terminal 34 of the transistor 32. The collector terminal 36, of the transistor, is connected to the terminating circuit 21.The terminating circuit is also connected to the first conductor 12a upstream of the sensing resistor 22.

The emitter terminal 38, of the transistor, is connected to the second conductor 12b.

The current flowing in the first conductor 12a is detected by sensing the voltage drop across the sensing resistor 22. The voltage drop is maintained at a minimum value by

selecting a relatively low value for the sensing resistor. The voltage drop across the sensing resistor 22 is measured by the differential amplifier 24.

Upon detecting current flowing through the sensing resistor 22 greater than a first predetermined threshold the input differential of the differential amplifier is significant and the output 30 is driven low relative to the voltage at the collector terminal 36. Therefore, the switching means 20 will remain open and the circuit 10 will be maintained as a continuing circuit. However, upon detecting no current flowing at, or less than, a second predetermined threshold the differential will be high and the output 30 will be high relative to the voltage at the collector terminal 36. Therefore, switching means will switch to connect the terminating circuit 21 second conductors 12 b and the network will be terminated such that the integrity of signals being transmitted on the network are maintained.

The first and second threshold may be the same to define a switching threshold, such as, for example, 0 Volts. Alternatively, the first and second thresholds may be different such that, for example, the switching means maintains a continuing circuit if a voltage greater than 3 Volts is detected and switches to the terminating circuit if a voltage of 3 Volts, or less, is detected. However, it will be appreciated that thresholds defining different voltages are equally applicable to the invention.

Referring to Figure 2, the network 14 comprises a plurality of nodes 16^1 to 16^N connected, from a host 17, by the first and second conductors 12a and b. Each node 16 comprises a respective electronic circuit 10^1 to 10^N disposed therein.

Upon a fault occurring, such as for example an open circuit at node 16^{N+1}, the current flowing through the first conductor 12a to that node will stop, or at least reduce. Such a fault causes a mis-match of the impedance of the network as a whole and therefore the integrity of the signals transmitted will not be maintained even in respect of nodes in which there is no fault. On detection of the changes of current flowing from node 16^N to 16^{N+1} the electronic circuit 10^N, disposed in node 16^N, switches it from being a continuing circuit to being a terminating circuit whereby the impedance of the network is matched by appropriate termination thereby maintaining the integrity of the signals transmitted.

CLAIMS:

1. An electronic circuit, capable of terminating a plurality of conductors at, or near, a node on a network, comprising detecting means, operable to detect current in at least one of the plurality of conductors, and switching means operable to switch the circuit between being a continuing circuit, upon the detecting means detecting current greater than a first predetermined threshold, and being a terminating circuit, upon the detecting means detecting current at, or less than, a second predetermined threshold.

2. An electronic circuit as claimed in Claim 1, wherein the terminating circuit comprises impedance matching means.

3. An electronic circuit as claimed in Claim 2, wherein the impedance matching means comprises a terminating resistor connected in series with a terminating capacitor.

4. An electronic circuit as claimed in any of the preceding claims, wherein the network is an active network and the node is an end node of the active network.

5. An electronic circuit as claimed in any of the preceding claims wherein the first threshold is greater than the second threshold.

6. An electronic circuit as claimed in any of the preceding claims, wherein the detecting means comprises a sensing resistor, connected in series with the at least one of the plurality of conductors, and means for detecting voltage across the sensing resistor.

7. An electronic circuit as claimed in Claim 6, wherein the means for detecting voltage is a differential amplifier.

8. An electronic circuit as claimed in any of the preceding claims wherein the switching means comprises a bipolar or field effect transistor.

9. An electronic circuit as claimed in Claim 8, wherein the transistor is connected to an output of the detecting means.

10. An electronic circuit as claimed in Claims 8 or 9, wherein the transistor is a NPN bipolar transistor comprising a collector terminal, connected to the impedance matching means, and an emitter terminal connected to the, or each, of the other conductors.

11. A node comprising an electronic circuit as claimed in any of the preceding claims.

12. A network comprising at least one electronic circuit as claimed in any of the preceding claims.

13. An electronic circuit as substantially herein described with reference to as shown in the accompanying drawings.

14. A node as substantially herein described with reference to as shown in the accompanying drawings.

15. A network as substantially herein described with reference to as shown in the accompanying drawings.

ABSTRACT:

An electronic circuit for terminating a plurality of conductors at a node of an active network, comprising means to detect current flowing through one of the conductors and means to switch between a continuing circuit, whereby continuity of the network is maintained, on detecting current above a first predetermined threshold, and a terminating circuit, whereby the network is terminated with an appropriate terminating circuit, upon detection of current at, or below, a second predetermined threshold.

1/1

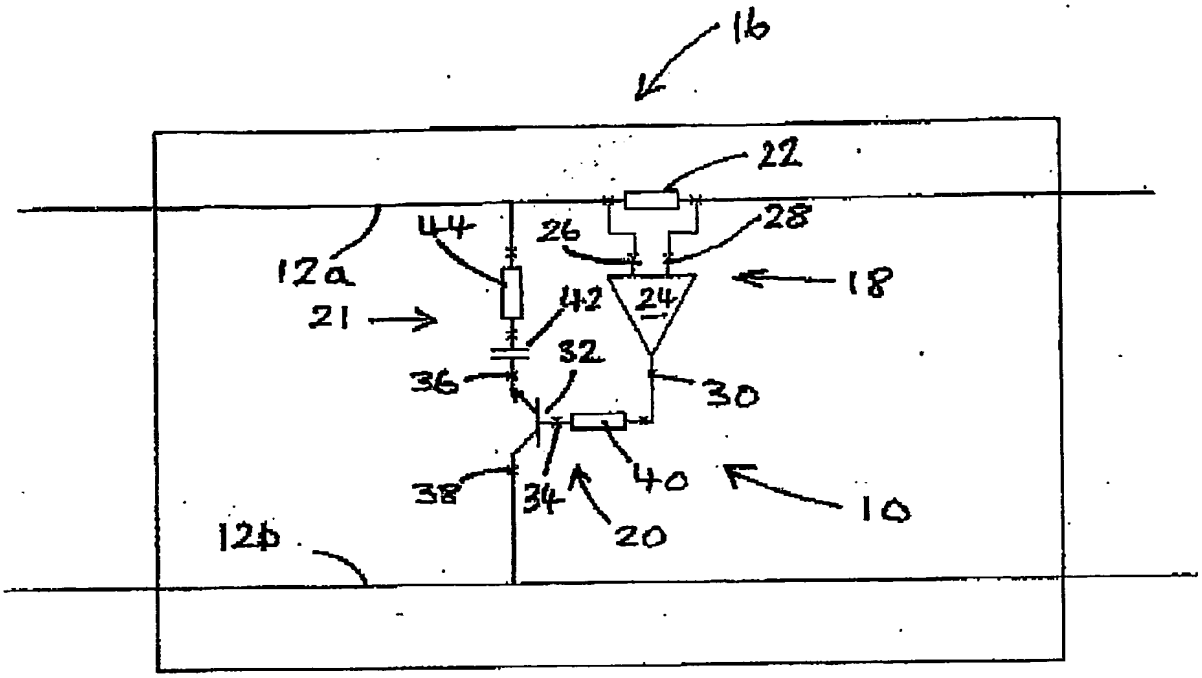

FIGURE 1

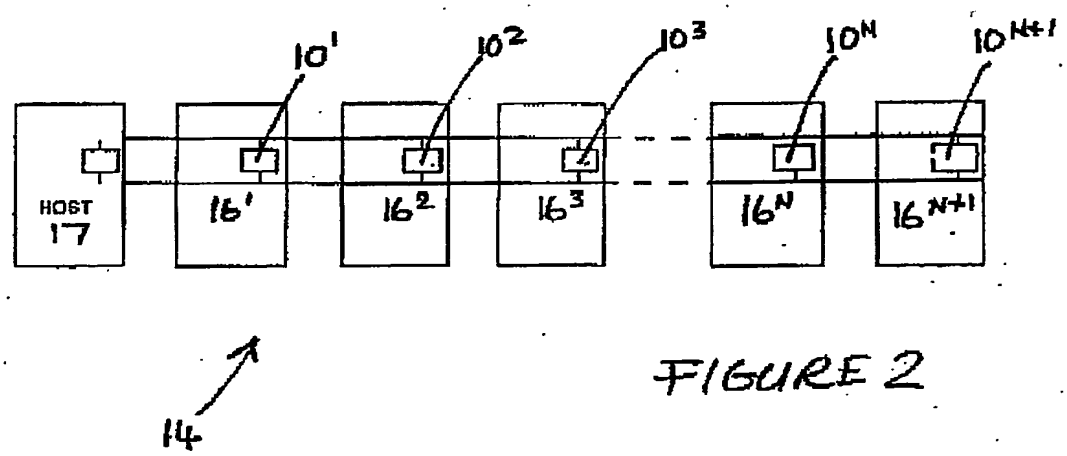

FIGURE 2

PCT/GB2004/004072